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ABSTRACT

This paper considers the role that teacher educators accord to subject matter knowledge in helping teachers to change their practice. Two inservice programs that aim to effect radical change in teachers' practices are examined, one focusing on the teaching of mathematics and the other on the teaching of writing. Drawing on data from interviews and questionnaires, as well as on observations of program staff members' work with teachers, the study analyzes how each program construed its subject matter and the role that subject matter knowledge was assigned relative to other kinds of knowledge and skills in helping participating teachers learn to teach mathematics or writing differently. The analysis shows that, for the most part, developing teachers' subject matter knowledge was not a top priority for either program. There seem to be two reasons for this situation. First, although both programs were centered on teaching a particular subject, the goals of the program staff encompassed fundamental changes in the roles of teachers and students and in teachers' views of learning and of learners. That participating teachers' knowledge of mathematics or writing tended to be thin underlies a second reason why staff members in both programs chose to emphasize other kinds of knowledge. The paper concludes with questions about choices faced by those who aim to change elementary teachers' practices in teaching mathematics or writing and the role of subject matter knowledge in learning to teach. (Author/JD)

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National
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on Teacher Education

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Research Report 90-8

THE CONSTRUCTION OF NEW FORMS OF TEACHING: SUBJECT MATTER KNOWLEDGE IN INSERVICE TEACHER EDUCATION

Deborah Loewenberg Ball and James H. Mosenthal*

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This paper considers the role that teacher educators accord to subject matter knowledge in helping teachers change their practice. Two inservice programs that aim to effect radical change in teachers' practices are examined, one focused on the teaching of mathematics and the other on the teaching of writing. Drawing on data from interviews and questionnaires, as well as observations of program staff members' work with teachers, the authors analyze how each program construed its subject matter and the role that subject matter knowledge was assigned relative to other kinds of knowledge and skill in helping participating teachers learn to teach mathematics or writing differently. The analysis shows that, for the most part, developing teachers' subject matter knowledge was not a top priority for either program. Two reasons seem to help account for this. First, although both programs were centered on teaching a particular subject, the goals of the program staff encompassed fundamental changes in the roles of teachers and students and in teachers' views of learning and of learners. That participating teachers' knowledge of mathematics or writing tended to be thin underlay a second reason why program staff members in both programs chose to emphasize other kinds of knowledge. The paper concludes with questions about choices faced by those who aim to change elementary teachers' practices in teaching mathematics or writing and the role of subject matter knowledge in learning to teach.

THE CONSTRUCTION OF NEW FORMS OF TEACHING: SUBJECT MATTER KNOWLEDGE IN INSERVICE TEACHER EDUCATION

Deborah Loewenberg Ball and James H. Mosenthal[1]

In teaching, teachers weave together many different kinds of knowledge and belief: of students, of how students learn, of the teacher's role, of pedagogy, and of the subjects they teach. What they do is shaped by considerations of the context and their disposition to do particular things under particular circumstances. Their knowledge, skills, and dispositions are, in varying measures, the product of what they experienced as pupils, whatever professional training they have received, and their experience as teachers. Inservice teacher educators and policymakers bent on helping teachers change and develop their practice must consider how to influence most effectively this complex web of ideas, understandings, and habits in ways that will shape what teachers actually do in their classrooms. Under conditions of limited time and resources, and given what is known about teaching and teacher learning, what aspects of teacher knowledge and practice are most fruitful to target?

Of the panoply of things that contribute to teaching, the one most frequently taken for granted and overlooked is teachers' own knowledge of the subject matter (Shulman, 1986). Most assume that teachers know the "stuff" they are supposed to teach, that the issue is helping learn different ways to teach it. Some, recognizing that teachers' own understandings may be thin or distorted, nevertheless believe that changing their ideas about learning or giving them better ways to present material will effect the most significant changes. Still others accord little importance to the role of subject matter knowledge in teaching, giving greater centrality to pedagogical techniques such as cooperative grouping, effective instruction, and questioning and discussion strategies.

Yet recent research (e.g., Ball, 1989; Carpenter, Fennema, Peterson, and Carey, 1989; Grossman, 1990; Hashweh, 1987; Lampert, 1986, in press; Shulman, 1987; Wilson, 1988; Wilson and Wineberg, 1988) suggests that teaching in new ways, in ways focused on understanding, is highly dependent on the teacher's own understanding and conception of the subject matter. Setting a worthwhile task for a group of high school juniors in a U.S. history class demands a significant depth of insight about history and historical ways of knowing. A writing class run by a teacher who spells and punctuates with precision but who conceives of writing as producing a neatly handwritten story in one sitting is unlikely to help students develop their capacities to express themselves effectively in writing. And it is difficult to imagine a teacher whose own mathematics education only focused on rules and

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[1]Deborah Loewenberg Ball and James Mosenthal, assistant professors of teacher education at Michigan State University, are senior researchers in the National Center for Research on Teacher Education. Order of authorship is alphabetical; both authors contributed equally to the conceptualization, research, and writing of this paper.

algorithms being prepared to help students unpack underlying meanings and engage in mathematical discourse (National Council of Teachers of Mathematics, 1989).

Significant demands are placed on teachers who try to teach in such adventurous ways (Cohen, 1988). These kinds of instruction rest on more uncertain and messy views of knowledge and place responsibility for instruction more squarely on students. The teacher's role in orchestrating and facilitating students' learning is uncertain and risky compared with the traditional mode of telling and showing. In trying to change teaching in a direction that so directly cuts against the grain of pedagogical and cultural tradition, what is the role of subject matter in equipping teachers to change what they do (Ball and McDiarmid, 1990)?

This paper takes a close look at two inservice programs, one focused on mathematics and the other on writing. Because these programs were ostensibly focused on teaching of particular subject matter, unusual for inservice teacher education, we were interested in examining how each program construed its subject matter and the role that subject matter knowledge was assigned relative to other program emphases in helping participating teachers learn to teach in ways that differed radically from what they had themselves ever experienced or done.

The Study

The two inservice programs examined in this paper were part of the Teacher Education and Learning to Teach Study conducted by the National Center for Research on Teacher Education (NCRTE). Eleven preservice, induction, alternate route, and inservice programs were studied to learn about the relative impact of teacher education on learning to teach. Researchers followed each program's participants over time to track changes in their knowledge, skills, and dispositions; to learn their reactions to the program; and to explore its effects on their practice as teachers. The research design varied to fit the nature and structure of the particular program (see NCRTE, 1988). In the two inservice programs discussed in this paper, participating teachers were interviewed and observed at intervals over the course of more than two years, beginning the spring before they began the program, throughout their participation in the program, and after they had completed the program. Researchers also documented program sessions and other work with teachers and interviewed program staff to learn about their purposes and rationale for what they were doing.

The analysis reported in this paper draws on data from interviews with program staff members, their responses to a questionnaire about the aims and values of the program, and observations of their work with participating teachers. We begin with a brief description of each program and its goals: What kind of teaching was the program trying to develop? What kinds of changes would this kind of teaching demand of the experienced teachers who participated in the program?

For each program, we discuss first how the program staff members seem to construe subject matter knowledge. What does it mean to know mathematics? Or to have knowledge of writing? Second, given this view of the subject matter itself, we examine the role given to teachers' subject matter knowledge, relative to other kinds of knowledge, in changing teachers' practices. The two programs are then compared and questions raised about efforts to change elementary teachers' practices in teaching mathematics or writing and the role of subject matter knowledge in learning to teach.

The Programs

The two programs examined in this paper are the SummerMath for Teachers program, Mount Holyoke College, and the Teachers College Writing Project; our analysis draws on data collected from 1987-1989. (Note, in referring to the staff of both programs, we use female pronouns in order to protect their anonymity.) Both elementary inservice programs, SummerMath and the Writing Project, represent sophisticated approaches to intensive, classroom-based, long-term inservice based in a subject matter. Both programs hold intensive summer institutes and conduct regular, year-round, classroom-based staff development and support. While the SummerMath program teachers come from many different individual schools, the work of the Writing Project is concentrated on teachers in particular New York City public schools. Both programs hold goals for practice that differ markedly from traditional teaching of mathematics or writing.

Goals for Teachers in Each Program: What Is Good Teaching?

Teaching mathematics from a constructivist orientation. The SummerMath for Teachers staff aimed "to help teachers develop their abilities to teach in a way that involves students in a problem-solving, active-learning approach to the learning of mathematical concepts." Teachers, according to one of the program's directors, have no real theory of learning; they think about teaching and about what they do, not about what students do with it. Consequently, teachers are inclined to tell and show students how to do mathematics instead of creating activities that help students to construct understanding of the content. Teachers must "give up responsibility for getting the students to the answer."

SummerMath was based on a view of mathematics learning, labeled by the program staff as "constructivist," which holds that individuals must construct their own understandings of mathematical principles and concepts. As one of the staff members explained, "What 'constructivism' means to us is that people don't take on meaning by hearing the meaning it has for someone else. They've got to have experience with the phenomenon to create meaning for themselves." Another staff member highlighted the importance of the learner "constantly accommodating and assimilating, constructing, changing one's own notions by reflecting and resolving contradictions."

According to this view, students must be actively involved, and their engagement must move from the concrete to the abstract levels, if they are to develop conceptual understanding and the ability to solve mathematical problems. Applying mathematics to novel situations, inventing strategies, and assessing the reasonableness of one's solutions are among the hallmarks of understanding. Telling and explaining are less the teacher's trade in this approach. Instead, the teacher serves as a guide, facilitating students' learning by posing problems and asking questions aimed at helping students clarify their thinking (e.g., "What are you trying to do?" or "What does the ½ refer to here?").

One of the program directors emphasized that the teacher's role, while not centered on telling and showing, was nonetheless crucial:

> It's not a matter of putting kids in a room with a bunch of interesting things and they'll discover the theory of relativity. No, a teacher plays a very important role in directing and making decisions and focusing students on particular concepts.

Still, she worried about how this could be distorted: "Frequently when we're asking a student [a question] we've already decided what that student has to connect it to." Another staff member emphasized the importance of the kinds of tasks students are given--that they must be tasks that students are ready for and that will provoke some conflict that they have to resolve. All the staff members agreed on the need for teachers to learn how to ask good, probing, questions.

Describing a teacher who was doing well, one of the program directors outlined three key features of the kind of teaching they were trying to foster:

> One is the *increased use of manipulatives*, . . . a second is that *questioning* is really improved . . . to the point where she is asking the kids questions that really get them to thinking about the "why" behind what they are doing and she is giving *problems that challenge kids* that aren't just routine exercises and she is starting to think about *extensions* to problems.

In sum, the program's vision of good teaching aimed to put teachers in the unfamiliar role of guiding students to explore and make sense of mathematics. They envisioned classrooms in which students would use manipulatives regularly to represent and solve problems, where word problems would be common tasks, and where much more of the class period would be spent with pupils working in pairs and small groups. And they assumed that all of these activities would be aimed at promoting the development of conceptual understanding, not just procedural skill.

The writing teacher as learner. In its work with teachers, the Writing Project presents a classroom model for writing instruction referred to as "the writing workshop." A major purpose of the writing workshop is to help effect radical change in the relationship between teachers and students in the classroom. One of the trainers explained the purpose of writing instruction in this approach: "To see kids defend a piece of writing, to make it their own, to articulate, talk, question--that, for me, is a purpose." In general, the writing workshop is based on the notion that instruction should be based on students and their ideas rather than on teachers and a specific writing curriculum.

The writing workshop is meant to provide a predictable environment in which students can write and interact with peers and their teacher over their writing. Typically, during the time of the writing workshop, the teacher and students meet briefly (5-10 minutes) as a group at the beginning of the workshop. Here, teachers talk to students about writing ideas or procedures that they feel will help students. What a teacher talks about is determined by what the teacher has observed in the students' writing in previous workshop sessions. These ideas are offered as suggestions and do not constitute an agenda for the day's writing. This time, referred to as a "minilesson," is the only time that the teacher directs instruction.

For the bulk of the workshop, students write, usually in a predetermined genre, and interact with each other or their teacher over their writing. These interactions are referred to as "conferences" and the activity as "conferencing." For the final minutes of the workshop, the teacher and students meet in a "share" session where certain students read what they have been working on and get feedback from their peers. This predictability of the writing workshop is thought to enable students to learn to control their own process of writing and to enable the teacher to learn to facilitate this growth.

This facilitative role of the teacher is at the heart of the workshop. For the Writing Project the workshop teacher is a learner. One of the trainers remarked: "We're trying to get at a teacher/student relationship. We're trying to give teachers some strategies for how to learn from kids and let their teaching evolve from what they're seeing in front of them." Another trainer stated:

> You have to know how to read students and be interested in them. [By "reading students" I mean] understand that they have a history and the moment of writing that they do is attached to their whole history [as] writers. That they are frequently very smart and know where they are going [in their writing] and [that you] have to find out where they are going before [you] have anything intelligent to say to them.

A third trainer, who is herself a professional writer explained:

> [I came to] realize that . . . the teachers can't aspire to be writers like I am. But what they can do is they can aspire to be learners. . . . The kind of mentor they can be for [their] kids is really as a learner and risk taker. . . . In this kind of relationship the kids are seeing their own teachers in the role that they're in as a learner.

The complementary ideas of teaching evolving from the students' writing, being able to "read" students, and modeling what it means to be a learner are conceptions of teaching discoverable, in principle, through workshop teaching.

The difference between the teacher and the students in the writing workshop is that the student is primarily a learner of writing, whereas the teacher is primarily a learner about students through their writing. In the workshop the primary goal for students is to grasp their autonomy in writing and the legitimacy of their attempt to express themselves in writing. This requires that the teacher give up control of the activity of writing to the student. In so doing, the teacher takes on the role of learner in trying to understand students' intentions in writing and to facilitate the students' achievement of their intentions. The focal point of all learning, by teacher and students, is the students' writing--their texts-in-progress. To understand and facilitate students' writing the teacher works through their texts.

The Nature and Role of Knowledge About Mathematics and Writing in Each Program

What is Construed as the "Subject Matter" of Mathematics?

In the SummerMath program, mathematics was seen to consist of a web of interrelated big concepts and topics: place value, for instance, as well as fractions, the distributive property, and functions. These ideas were seen as interconnected, rather than a set of discrete topics as they are frequently represented in textbooks. These ideas can be understood conceptually, not just memorized. For example, one of the staff members explained, understanding place value entails being able to model the regrouping algorithms with concrete objects, not just to say "if you get 17, you put down the 7 and carry the 1."

A child who, in computing 32 + 19, makes 32 little slashes and 19 little slashes and then circles groups of 10, likely understands place value better than the one who uses the standard carrying procedure. A child who can use blocks to model 32 + 7 understands division better than one who can simply compute the answer. Reporting the formula for perimeter is not evidence of understanding what perimeter is. Being able to answer a question such as, "What is the minimum perimeter for a rectangle with an area of 40?" reveals a deeper understanding of the difference between linear and area measurement as well as of the relationship between perimeter and area.

Understanding mathematical ideas was construed by the program as being able to represent those ideas concretely and pictorially, as well as to deal with them abstractly. Using concrete objects or pictures to model and solve mathematical problems was identified by all of the staff members as a criterion for assessing the kind of mathematics teaching they were trying to foster. Counters, Unifix cubes,[2] paper strips, and base-10 blocks were important vehicles for working meaningfully with mathematical ideas.

In the summer institute, staff members planned experiences for the teachers that engaged them in "thinking more deeply" about place value, algorithms for addition and subtraction, fractions, volume, area, and perimeter. One day in the summer institute, the teachers worked with fractions. What did 3/8 *mean*? They explored, using a story about pies, how 3/8 could mean 3 divided by 8: "I want to share my 3 pies evenly among 8 people." And, later they investigated what 2/3 of 3/4 gallon of ice cream meant. One teacher remarked, "I always tell kids that 'of' means multiply." The leader asked,

> What does this 3/4 refer to? The gallon of ice cream. What does the 2/3 refer to? It uses the whole as 3/4 of a gallon. You begin to see why this is a confusing concept. It is very difficult to think of a part of a part.

They discussed the different representations that could be used to model fractions: pies, geoboards, strips of construction paper, fraction bars, Cuisenaire rods. "There's some good research that shows that if we use two or three or more representations, we get stronger concepts," commented one of the staff members.

Changing the Teaching of Mathematics: The Role of Subject Matter Knowledge

In the summer institute that launched the program, the mornings were spent either with the teachers themselves engaged in doing mathematics or else watching children doing mathematics. These lessons help to illuminate the view of mathematics (as well as of teaching and learning) to which the SummerMath staff was committed.

One day, Barb, who led most of these mathematics sessions, did a lesson with six children, 8- to 10-years old, using Unifix cubes. She told them stories and told them to use the cubes to show "what's going on." For example, she said, "In your lunch box you had 2 cookies, then a friend gave you 3 cookies. Can you show me that with the blocks?" The children pulled out blocks to represent the problems and Barb gave them another problem.

After a few more examples like this, Barb gave the children each a worksheet with a set of such stories and told them to show them with the blocks. "Talk to your partner," she urged. While the children worked, Barb walked around, asking questions such as, "Tell me

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[2]Unifix cubes are colorful plastic interlocking blocks which can be connected to make long sticks, useful for modeling addition and subtraction as well as for measuring.

the story. Can you put the blocks in a way that I could see the 6 packs?" After about 15 minutes, Barb led a brief sharing session in which the children showed one of the problems and the way they represented it with blocks.

Brenda, another staff member, led a discussion to "process" the lesson. Teachers commented on pacing, on how to get children to work well with blocks, on the questions Barb had asked. They discussed the importance of the probing, not leading, questions. One said that they are useful to "help kids clarify in their mind." Another noted that such questions allow the teacher to "step back and watch children construct their own knowledge." One teacher explained that probing questions are important because, when teachers use leading questions, they are taking responsibility for learning, not the child. She added that a crucial consideration is how much sense of "ownership" they have over their own learning.

Throughout this discussion, the teachers and the staff concentrated on unpacking Barb's pedagogical approach during the demonstration lesson. No references were made to the mathematics. Finally, Barb, glancing at the clock, wrapped up the discussion with a question, focusing the teachers on the subject matter. She remarked, "There was one thing that was conspicuously absent from this discussion. What kind of math were they doing? What did you think about the math?" Directing the teachers to "reflect on that tonight in your journals," she sent them off to lunch.

The demonstration lesson highlights several key features of the program's view of mathematics and of the teaching and learning of mathematics. The mathematics of the lesson, in which students used blocks to represent and solve word problems, focused on representing the meaning of the arithmetic operations required to solve the problems and the meaning of the answers. Each problem had only one correct answer, although presumably more than one reasonable representation would be possible. Comparing their answers, the children were encouraged to rely more on one another and less on the teacher as the judge of whether or not their answers were right. The teacher's role is to watch what students do and to refocus them with questions when they go astray; questions are also used to find out what students are thinking and to get them to clarify their ideas. Students work alone and with others; group discussions focus on reporting out from individual and small group work.

Although mathematics was the stuff which engaged the participating teachers, the central subject matter of the program was constructivism, or knowledge about learning. The goal of the mathematical experiences was at least as much to get teachers to rethink their assumptions about *learning* as it was to "make a dent in their concept of mathematics." One staff member, asked about the knowledge teachers would need in order to teach mathematics for understanding, revealed this primary interest in learning:

> In the summer institute we give them mathematical experiences that they then reflect on and talk about what was potent for them in their learning that they went through. Out of reflecting on what they went through they begin to talk about constructivism. They may not even use the word constructivism but they're talking about how it was real important for them to start with concrete objects and depending on what they did. . . . They noticed that the staff did not do any telling, but instead did a lot of opening and probing and they noticed that wait time is real important. They noticed that getting people to paraphrase and listen to each other and ask each other questions was important. So in a sense, by the end of the two weeks, they have somewhat of a--they are already beginning to form a philosophy about constructivism. Then when we work with them [individually] . . . they are developing the concept of constructivism through the year. *So in a sense we are trying to help teachers construct constructivism.*

Other staff members echoed this perspective, emphasizing the need for teachers to come to value students' *inventing* mathematical ideas. They talked about the importance of using manipulatives and working cooperatively in groups. On the questionnaire administered to the program staff, there was complete agreement on the centrality of notions about learning. In reflecting on program purposes, for example, all four staff members indicated that learning about how pupils learn was most important.

One striking way in which the program's emphasis on changing teachers' ideas about learning came through was an afternoon physical education experience. Each day of the two-week summer institute, right after lunch, the 30 teachers walked across campus to the college gymnasium where half of them took tennis and the other half took dance. The program's director explained that the purpose of this component of the program was to give the teachers a chance to think about learning in another context, to pay attention to their own experiences as learners: What helped? What was scary? What was the teacher's role? That the program chose to engage teachers in a *learning* activity rather than another *mathematical* one is telling.

Constructing This New Form of Mathematics Teaching: What Is Entailed?

The kind of teaching envisioned by the SummerMath for Teachers program staff differed substantially from the sort the participating teachers had themselves experienced and practiced. Traditional mathematics teaching consists of the teacher showing students how to do particular procedures and having students practice to gain competence and skill. Good teaching in this tradition consists of clear explanations, some use of models, some use of real-world applications. Good mathematics classrooms are quiet and orderly, student talk minimal. "Do your own work," "Be neat," or "How many pages can you get done today?" are common exhortations. Understanding consists of being able to get the right answers

using traditional procedures and algorithms and being able to apply these procedures to solve word problems.

Teaching in the way envisioned by SummerMath demands that teachers change the role they play, from one of director and teller to one who facilitates and responds. To do this, teachers must be able to create or select worthwhile tasks that will generate disequilibrium in students' thinking. They must be able to listen to students' mathematical ideas and decide what to say or do to help students extend their understandings. Not only are these activities and roles unfamiliar and even uncomfortable to experienced teachers, but they demand substantial knowledge of mathematics. What makes a task worth doing? When a student invents a nontraditional method for solving a problem, does it make sense? When a student proposes a generalization, is it valid? Is it worth pursuing or focusing on? Can something a student brings up be connected to another big mathematical idea? When students make claims, are their assumptions about proof legitimate?

Participating teachers' images of mathematics teaching grew out of experiences with the traditional pedagogy described above. Moreover, their understandings of mathematics, developed through such kinds of teaching, tended to be rule-based and focused on computation. For example, asked to generate a story or real-world context for 1 3/4 ÷ ½, six out of seven of our focal teachers confused division by 2 with division by ½. Only two out of seven were able to explain the place value basis underlying the multiplication algorithm for large numbers. And only one understood that perimeter and area were not directly related: that the perimeter of a rectangle could increase while maintaining a constant area or vice versa. While many were inclined to do more with "problem solving," they still tended to see computational skill and procedural efficiency as "basic."

The staff members themselves were unevenly oriented to mathematics. Only two of the four had any extensive study of mathematics at the college level. One commented, "I'm kind of a generalist. I got involved with this program because I think it's really exemplary in its use of constructivism." Two had taught secondary mathematics, two had taught elementary.

No one in the program denied the importance of subject matter knowledge to the kind of teaching they were advocating. However, their comments about subject matter had the tone of "it would be nice and it really does make a difference in this kind of teaching but teachers don't have it and we have decided that it is more fruitful to start with their ideas about learning." For example, one staff member, acknowledging that her own mathematics was "weak," said that

> teachers can feel comfortable teaching this way if they're willing to investigate with kids. If they are willing to try different examples, if they are willing to take the manipulatives themselves and play with them. I don't think that people have to be wonderful mathematicians to succeed in this program. I do

> think that having no mathematical background is a hindrance and the people I've seen do the best are the people who are stronger in math. But I certainly don't think you have to be a real good mathematician to succeed in this kind of teaching. I think you have to have some other--you have to be open-minded, you have to be willing to investigate with kids, you have to be able and willing to not feel that all the answers have to come from you, that they can come out of investigating.

She said that, in the summer institute, "we do some things in the mornings with math . . . we don't just leave it out." She said she also tries to do some work in mathematics with her teachers during the year but "we don't always have the time." Working with pupils in these ways, she thought, would help the teachers to develop their own subject matter understandings: "I know my own mathematics has gotten stronger by working in the program so I guess if I figure that I've gained, then I know the teachers are going to gain too."

But it was clear that gaining conceptual understanding of mathematical ideas was not her top priority for the teachers:

> Even though they may not come out with the correct mathematics at the end, at least if I can eradicate some of the math anxiety and get them willing to investigate and get them themselves to be willing to pick up manipulatives and get them so that they are willing to test out ideas, that they are going to get stronger.

Her conviction was that teachers could do a good job of this kind of teaching without necessarily knowing mathematics deeply themselves:

> I'm not sure that's a necessary component of this. . . . I don't think it's as necessary as we like to think it is. One of the things that is wrong with education is that we've always assumed people had to know a bunch about stuff before they could teach it. I'm not trying to paint the opposite picture that you don't have to know anything in order to be able to teach, but I think that learning, that powerful learning can occur when teacher and child are investigating together. The teacher doesn't always have to know the answer. One of the problems when we *do* know answers is that it's too hard for us not to want to tell. So I think that successful teaching can occur with not always knowing.

Another staff member explained that "the piece that we're more invested in is that they get the idea of children inventing." Toward that end, she argued, teachers need to "experience learning in a constructivist fashion."

The two staff members who were more grounded in mathematics themselves had stronger convictions that teachers needed to understand mathematics well themselves. One explained that many of the teachers were used to thinking about mathematics only enough to turn the page and that "70 percent of the problem" was that they are "not clear on what the concept *is*." She continued,

> I want the teacher to know and understand it. I think the teachers can sometimes do useful things in a classroom if they have certain skills, even if they don't understand the problem, but I basically believe the thorough understanding--in not only how to solve it, but what it is connected to conceptually--is a much better basis for [teaching].

The other stressed the need for teachers to have a broad perspective of what mathematics is: "I think it's important for the teachers to have a much broader perspective of what mathematics is so they can . . . deal with their own students' ideas . . . with much more knowledge." She admitted to having "corrected the mathematics of the teacher" when she worked with some in their classrooms. Still, both of these staff members emphasized that changing teachers' conceptions of the teacher's role and of learning was key.

The SummerMath staff members' concerns for the role of subject matter knowledge in this kind of teaching differed, from some who saw it as of minor importance to some who saw it as quite important. Still, the program chose to emphasize helping teachers develop their ideas about learning, even as they engaged in mathematics themselves. Program activities involved teachers as learners in doing mathematics and solving problems, alone and in small groups.

For example, over the course of two mornings in small groups, the teachers constructed numeration systems without relying on conventional knowledge of place value or base-10 numeration. They wrestled with ways they might represent different quantities and how operations with those quantities might be symbolized and performed. On another day, they worked with volume, trying to figure out how many shoeboxes would fit in the hall where they were working. Staff members asked questions that probed the teachers' ideas as they worked (e.g., "What are you trying to do with that sketch?" or "What does this A represent?"); never did they show how to solve a problem or confirm an answer.

At the conclusion of these activities, staff members would ask teachers to step out of their role as learners to examine the pedagogy of the program. These discussions were similar to the "processing" of the demonstration lessons, as described in the preceding section. For example, after the numeration activity was completed, one of the staff members opened the discussion by saying,

> You've had the experience over the past three days of being math students and I daresay that what you experienced is at least somewhat different than what you experienced growing up. I would like for us as a group to pull together some ideas from that experience, what it has been like, some reflections on what it means to us, what sense we are making of it. I'd like to start out by having you pull out some of the characteristics you have noticed about the teaching. And when I say "the teaching," I'd like you to include the design of the lesson, the small-group activities, and the large-group activities. What's *not* part of the math lesson is when we ask you to step *out* of the role of being a student and talk about the teaching and learning.

Teachers jumped into this discussion, commenting that they had been "guided, not led" to figure out solutions, that they had used manipulatives, that they had had opportunities to listen to others which helped them to expand their own ideas. One teacher commented that "the relationship between the teacher and the student is different from what we grew up with or what we are seeing in classrooms right now." Another teacher elaborated, saying that "in this setting, the teacher is fostering independence, questioning our *own* answers, how to go on our own" instead of looking for "conformity."

What Is Construed as the "Subject Matter" of Writing?

In talking about writing with the trainers of the Writing Project, it is apparent that there is an assumed body of knowledge about writing easily referenced in discussion. The referential knowledge includes knowledge about writers or authors and their audience, about stages of writing including drafting and publishing, about processes such as revising and editing, about text characteristics such as topic and detail, and about types of genres such as personal narrative, poetry, picture book writing, and autobiography. However, this knowledge about writing is subordinated to the central figure of the writer who writes texts. Writing is about writers. This orientation of the Writing Project seems to have its roots in the work of writers writing about writing. Frequently in the Summer Institute and staff development, reference was made to Peter Elbow's *Writing with Power* (1981), Donald Murray's *Write to Learn* (1984), and William Zinsser's *On Writing Well* (1985). This disposition to see writing through "writers' eyes" and in terms of "what writers do" permeated the discussion and work of the Writing Project trainers.

Thus, in order to discuss how the Writing Project construes the subject matter of writing we must introduce another type of knowledge to complement this referential knowledge. For the trainers of the Writing Project there is what might be called a knowledge of intent which complements the referential knowledge of writing described above. This knowledge is a knowledge of the writer's purposes in writing and how those purposes or intentions are realized. To understand their rationale for their staff

development we need to focus on how the Writing Project construes intentional knowledge about writing.

In a discussion of conferencing, one trainer framed an intentional knowledge about writing in terms of the interactive relationships between the writer, the process of crafting a text, and the medium or genre in which the writer writes. At one point in talking about her goals for working with teachers, the trainer stated:

> Using the medium [in this case picture books] hopefully to teach teachers about writing process. . . . In other words, we're always trying to get under the deeper issues like how we can help kids read their own drafts, make kids critical readers of their own--make kids their own first readers of the text. Kids don't know how to read their own drafts. Or how to . . . explore a piece of writing with a kid, go around with it and then teach in a way that does not get the kid to writing it in your vision. Those are the generic issues that come up again and again no matter what kind of writing you're talking about.

When probed on whether, in conferencing, she put more emphasis on the students' writing process or on the type of text being written, the trainer responded:

> They're a little bit meshed. On the one hand clearly I want the kid to have a successful experience in poetry. I want the kid to write a good poem. I want the kid to write a really good picture book that he can be proud of. But I also try to get the kid--well trying to get the teacher to see that through this medium we can give the kids an authentic writing experience, try to craft literature and also to teach them something about good writing that pertains to any kind of writing that they do. . . . Ultimately we're trying to teach the writer, we're not trying to teach the piece.

Here, the purpose of writing is to engage in the process of crafting text, and this engagement is shaped or understood in terms of the medium in which writers write. The trainer explained that this engagement incorporates the ability of writers to read their own text critically. The implication is that writers have the best hold on what they are trying to do and are therefore best situated to read the text to see if it accomplishes what they want it to. More important, though this awareness is assumed of most writers, it is an awareness that must be learned. Children do not naturally control their own writing process to the extent that they see themselves as autonomous authors whose social interactions in the workshop are facilitative of their purposes for writing. In general, a basic premise of an intentional knowledge about writing is that writers need to be aware of their intention to express their ideas. The writing process is what writers do in progressively trying to close the gap between their intent and their expression.

This belief in the centrality of the writer's intentions seemed basic to how the Writing Project construed knowledge about writing and the role of such knowledge in instruction. Another trainer makes this point explicitly:

> It's incredibly important to figure out what it is that the author's attempting to do and what it is that he's, he or she's achieved. Same way it is for kids in a classroom. You need to figure out what their logic is first behind the piece. . . . It doesn't do much good to tell someone . . . that "this is interesting but needs development.". . . It doesn't really mean anything.

However, in the trainer's comments on the role of the medium, no explanation was given on how the medium teaches about process, intention, and the experience crafting text. We might infer that the nature of a writer's intention is qualitatively different when writing in different genres because a genre requires a specific and special way of thinking and thereby helps to structure or focus the experience writing. Support for this interpretation of the trainer's comments came from one of the trainers who was a writer by profession. In talking about a typical session in a classroom, she discussed how her work in the writing workshop differed depending on the genre in which she and the classroom teacher were working.

> With the poetry I read it back to them a lot. . . . I talk more about the image and closing your eyes and revisioning in poetry. . . . With poetry I find that there is a lot more separateness. There's a lot of people looking out the window with pieces of paper and going over to the Poetry Corner and reading.
>
> In the fiction what I might do that's different is talk about believability and credibility. "Does this sound like it could really happen?" . . .
>
> There is a limit with report writing. There's a structure. They have to learn how to do research and get outside information. So that's something I have to keep in mind. . . . The conferences, it was just me going around and . . . asking them what their questions were about their subject and kind of validating [their questions]. . . . [Then the teacher and I assembled a lot material] so they could have access, especially in first grade . . . to some kind of written material. As well as the interviewing stuff, other kids, [parents, other adults]. . . . Then they wrote their report.

For each genre discussed, the trainer made reference to the distinctive phenomenon which is the focus of the writers' intentions given the genre in which they are writing. For the trainers, in poetry it is the image, in fiction the event, and in report writing it is the fact. The representation of these phenomena each has different criteria of "goodness." In poetry, it is the clarity of the image; in fiction, the believability of the event; and in report writing, the legitimacy of the fact. These criteria entail different manifestations of good writing

process: The clarity of the image is the result of "revisioning." The believability of the event is the result of monitoring one's portrayal of the event. The legitimacy of the fact in report writing is the result of researching the questions posed about a subject.

In this depiction of writing, process and medium are inherently intertwined. As a statement about how the Writing Project construes the subject matter of writing, it depicts the multifaceted process by which writers try to narrow the gap between intention and written expression.

Changing the Teaching of Writing: The Role of Subject Matter Knowledge

For the trainers of the Writing Project, it is this intentional knowledge about the complex relationship between intent, process, and medium that characterized how they thought writing worked. And it is this knowledge of the subject matter that drove their staff development. However, given the belief that the teacher should not aspire to be a writer but model being a learner, the Writing Project did not think that the teacher's knowledge of writing should be like the trainer's. It is not a goal of training to make teachers subject matter experts in the way trainers are. Rather, a primary goal of the Writing Project is that teachers perceive themselves as learners about and facilitators of children's intentions in writing.

This perspective on the teacher as a learner about students through their writing translates rather directly into staff development work. A major portion of work in the summer institute and in the classroom-based staff development involves looking at and responding to students' texts and to trade texts of the genres in which students write. What is emphasized is looking and responding "with writers' eyes" such that what stands out as craft or intention in the text is noticed and pointed to. Knowledge is knowledge about the crafting of text around an intention as this is learned from one's own responses and the responses of peers.

In the following example of staff development carried out by a trainer, we describe a trainer's work with teachers over the course of a day. The focus of the work is on getting students to develop an intention or initial vision of a text. On this particular visit the trainer was working with teachers and their students on notebook writing. Notebook writing is a means for generating and selecting ideas to be developed as a text of a genre. As a means for idea generation and selection it represents a focus on coming to terms with one's intentions for a text.

The trainer had been working with a group of teachers for about five weeks. During her previous visits she worked with teachers helping them to show and explain to students how notebook writing worked. On her prior visit, the trainer and the teachers agreed that many students seemed to have grasped notebook writing and were ready to "get out of the notebook" to develop an idea for a text. But over the course of the day she realized that

the students and teachers had not been able to get outside their notebooks. As a result, the general theme of the work in the classrooms and with the teachers focused on minilessons, conferencing, and sharing that dealt with getting outside the notebooks to develop an idea that was of special interest to the writer.

The conference with the teachers at the end of the day occurred in two parts: a general discussion about the children's resistance to getting out of the notebooks and a discussion of samples of children's notebook writing. For both, the discussion became a discussion of the teachers' resistance or uncertainty in helping children to grasp an idea to develop outside of their notebooks. This part of the discussion led to one on the need for the teachers not to be judgmental about children's writing and to see the potential in what students chose as an idea to develop in a text. In the end, the trainer and the teachers discussed several suggestions that had to do with the pedagogy of notebook writing. These suggestions focused on ways of looking at and providing more response/validation to students' attempts to articulate ideas and to select from among ideas.

Constructing This New Form of Writing Instruction: What Is Entailed?

The effort to go outside the notebooks was problematic for reasons apparent when viewed from the perspective of an intentional knowledge about how writing works. Notebook writing presumes that many ideas will be generated but only a few selected. The process of selecting an idea or ideas is potentially problematic because it requires that the writer work to see some sort of "vision" or "logic" of a text for which an idea or pattern of ideas is a seed. In addition, getting out of the notebooks requires that students and the teacher perceive notebook writing as preliminary to recognizing and selecting an idea that is meaningful and can be developed as a text of a genre. These are not pedagogical difficulties, but ones that reflect the need for teachers' strong intentional knowledge of writing.

It is difficult to determine how these types of problems may be overcome. In the conference at the end of the day, the trainer and teachers reached the conclusion that they needed to provide greater response/validation to the students' own approximation to generating ideas and developing a vision for a text. The teachers needed to cease being judgmental about students' writing and to encourage their attempts to engage this basic and difficult aspect of the writing process--coming up with an idea for a text.

At one level, this openness to the students' work falls within the purview of the idea that a teacher is a learner about the student. This is a difficult role to assume for it goes against the grain of the traditional role in which the teacher communicates standards and evaluates students' work in terms of those standards. However, as noted in the description of the writing workshop and the goals of the Writing Project, it is this leveling of roles that

the Writing Project seeks to achieve. In this respect, what is required to overcome the problems of notebook writing is pedagogical in nature.

In contrast, as became apparent in the conference between the teachers and the trainer, the teachers themselves were uncertain about the relationship of notebook writing to a writing process and the crafting of text. The teachers did not seem to understand how notebook writing could function as a means of developing students' intentional knowledge about writing. Here, what is required of the teachers is a strong intentional knowledge of the subject matter in order to cultivate an emergent understanding of the goals of notebook writing. Interestingly, the Writing Project, as noted, does not expect the teachers to have a deep knowledge of the subject matter. Rather, the goal is to have teachers become learners about their students through their writing.

Thus, the workshop teacher is confronted with the difficult challenge of teaching as a learner about students through their writing, without a deep knowledge of writing. Given this challenge, the Writing Project gives emphasis to a workshop approach to teaching in which the teacher and students can learn to operate as co-learners. Through the students' writing, the teacher and students learn to engage the medium of writing in order to learn about writing as a process of crafting text. Though the teachers and students are exposed to much information about the medium, as witnessed in the extensive writing done in various genres, the Writing Project trainers did not make knowledge of such topics and concepts the goal of their staff development. The medium was always vehicular, a means to learning how to look and respond to texts.

Discussion

At the beginning of this paper we raised the general question, what aspects of teacher knowledge and practice are most fruitful to target in helping teachers make radical changes in their practice, from traditional to "adventurous" instruction (Cohen, 1988). We pointed to significant work on teachers' subject matter knowledge which argues that teaching for understanding is dependent on the teachers' own conception and understanding of subject matter. We then set as our task to investigate how and to what extent subject matter knowledge is targeted in the SummerMath and Writing Project inservice programs which focus on the teaching of particular subjects: mathematics and writing.

What we found is that neither program makes primary the development of teachers' own subject matter understandings. Instead, both programs emphasize students' construction of knowledge within the subject matter. Two reasons seem to account for this: (1) the view of teaching and learning that permeates the orientation of both programs; (2) program staff members' sense of the realities of elementary teachers' subject matter backgrounds in either mathematics or writing.

Learning as Construction, Teachers as Facilitators

Both SummerMath for Teachers and the Writing Project conceived of learning as a process of personal construction, of the teacher as a facilitator of that process for students. When discussing the goals of SummerMath, one staff member pointed to the importance of the learner "constantly accommodating and assimilating, constructing, changing one's own notions by reflecting and resolving contradictions." This is similar to the perspective of the Writing Project trainer who described the purpose of the Writing Project: "To see kids defend a piece of writing, to make it their own, to articulate, talk, question." Teachers in SummerMath are encouraged to "give up responsibility for getting the students to the answer," to unlearn old habits of leading and hinting and showing.

Writing Project teachers are urged to be co-learners with their students, to be less concerned with good products than with "exploring a piece of writing with a kid, go[ing] around with it and then teach[ing] in a way that does not get the kid to writing it in [the teacher's] vision." In both cases, the view of teaching promoted by the program places the student in the driver's seat and the teacher in the role of listener, responder, and facilitator. As such, the programs chose to help teachers develop the commitments and dispositions to step down from the driver's seat and to let students explore, rather than to build up the teachers' own understandings of the subject matters. If teachers are to give up the directive, central role they have always taken, then working on changing their habits in this domain seemed critical to staff in both programs.

Dilemmas of Change and Choice

Staff members in both programs faced a thorny dilemma. Knowledge of the territory is important to helping students construct meaningful understandings through thoughtful engagement with problems and texts. In SummerMath, staff members, for the most part, acknowledged the advantage held by teachers who had a strong background in mathematics. In the Writing Project, trainers recognized the advantage of teachers who were "richly literate." Against this awareness, the two programs argued that a goal of teaching in the elementary schools is a constructivist or learner-based classroom that does not rely on the teacher's role as expert and authority on the subject matter. Instead of focusing on developing teachers' understandings of a wide range of subject matter topics and tools, programs seemed to have focused on changing teachers' conceptions of what it means to engage students in writing or in mathematics.

As is apparent, the role of subject matter knowledge presented a dilemma for both programs. The goals of both SummerMath and the Writing Project require that the teacher promote learning activities that are intellectually honest to inquiry in the subject matter (Bruner, 1960). Given this concern for the integrity of the student's engagement in a subject matter, we ask, what is the balance between knowledge of the territory and knowledge about

making sense in a situation revealed by the subject matter? If the situation which a learner engages in is inherently challenging--a frontier in the student's understanding of the territory of the subject matter--is not the challenge a function of previous engagements in the territory? More practically, to what extent is a third-grade teacher's capacity to teach from a constructivist or learner-based perspective a function of the teacher's rich knowledge of a subject matter?

Conclusion

Dewey's (1902) well-known distinction between what he called the "logical" and the "psychological" aspects of subject matters and experience is helpful in casting a somewhat different light on the content and focus of such teacher education. His argument suggests that choosing between emphasizing knowledge about learning or knowledge about subject matter sets up a false dichotomy in thinking about how to equip teachers to change their practice:

> We may compare the difference between the logical and the psychological to the difference between the notes which an explorer makes in a new country, blazing a trail and finding his way along as best he may, and the finished map that is constructed after the country has been thoroughly explored. *The two are mutually dependent* [emphasis added]. Without the more or less accidental and devious paths traced by the explorer there would be no facts which could be utilized in the making of the complete and related chart. But no one would get the benefit of the explorer's trip if it was not compared and checked up with similar wanderings undertaken by others. (pp. 19-20)

Dewey argues that "the map does not take the place of the actual journey." This is consistent with SummerMath and the Writing Project's emphasis on having students engage in territorial journeys. But Dewey also argues that the map serves importantly to guide and direct experience, the wanderings in the territory.

He conceived the logical as intertwined with the psychological, the record of past journeys as interwoven with having productive journeys. Thinking about teaching, Dewey (1904/1964) confronted and wrestled with the same dilemma faced by teacher educators today: What is the role of the teacher's subject matter knowledge in helping students journey? Recognizing and respecting students' thinking and work is, he argued, profoundly affected by the teacher's knowledge of subject matter: "Scholarship per se may be the best tool for training and turning out good teachers" (p. 159), for subject matter knowledge is at once logical--the ordering of past human experience--and psychological--the methods of the human mind itself.

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